DUFFIELD ASSOCIATES

5400 Limestone Road
Wilmington, DE 19808
Phone: 302.239.6634
Fax: 302.239.8485
duffnet.com

March 8, 2012

Via Electronic Mail

Douglas Polt, AIA, NCARB
Polt Design Group
1301 Enterprise Court, Suite 103-C2
Bel Air, Maryland 21014-1847

RE: Project No. 6772.GF
Geothermal Feasibility Study
Proposed Building 5 Renovation
VA Medical Center
1601 Kirkwood Highway
Wilmington, Delaware

Dear Mr. Polt:

Duffield Associates, Inc. (Duffield Associates) has completed our geothermal formation thermal conductivity testing at the VA Medical Center located at 1601 Kirkwood Highway in Wilmington Delaware. These services were provided in general accordance with our agreement dated October 18, 2011.

On February 23, 2012, a 350-foot deep, vertical, closed-loop geothermal test well was installed at the project site, in a location accessible to the drill rig, and in an area jointly selected by representatives of Duffield Associates and the VA Medical Center. The test well location was selected to be within the area of the proposed geothermal well field. Due to the presence of several large trees at the time of our evaluation, the areas that were accessible for the well installation were limited. An aerial photo showing the location of the test well is enclosed.

To install the well, a 6-inch diameter borehole was advanced to a depth of approximately 350 feet below grade. A 1¼-inch diameter, high density polyethylene pipe loop with a pre-fabricated u-bend was installed in the borehole to a depth of 350 feet. The borehole was subsequently grouted between February 23, and 24, 2012 with bentonite grout. The well was installed by K.L. Madron Well Drilling, as a subcontractor to Duffield Associates.

The subsurface conditions at the site of the geothermal well consisted of interlayered clayey and sandy soils overlying rock (gneiss). Rock was encountered at a depth of approximately 60 feet below the ground surface, and continued for the extent of the boring.

From February 29 through March 2, 2012, a formation thermal conductivity test was performed on the test well. The testing was performed by Duffield Associates' representatives utilizing equipment leased from Geothermal Resource Technologies, Inc. The test was conducted in general accordance with ASHRAE's recommended procedures by circulating water through the well for a total period of approximately 42 hours while measuring the heat input and the entering and exiting temperature of the circulated fluid.

The results of the testing are as follows:

- Formation Thermal Conductivity = 1.34 Btu/hr-ft-°F;
- Formation Thermal Diffusivity = 0.88 ft^2/day;
- Average Heat Capacity = 36.5 Btu/ft^3 -°F ; and
- Undisturbed Formation Temperature = 56 to 57.7 °F.

Further details regarding the testing methods and test results are provided in the enclosed report.

Following completion of the thermal conductivity testing, the testing equipment was removed and the exposed ends of the piping were covered with end caps taped in place. The pipe loop was left filled with water. The well should be flushed prior to future use in the designed geothermal system, or should be abandoned if it is not incorporated into the permanent geothermal closed-loop system.

We appreciate this opportunity to be of service to you and your team on this project. Should you have any questions concerning this study, please do not hesitate to contact us.

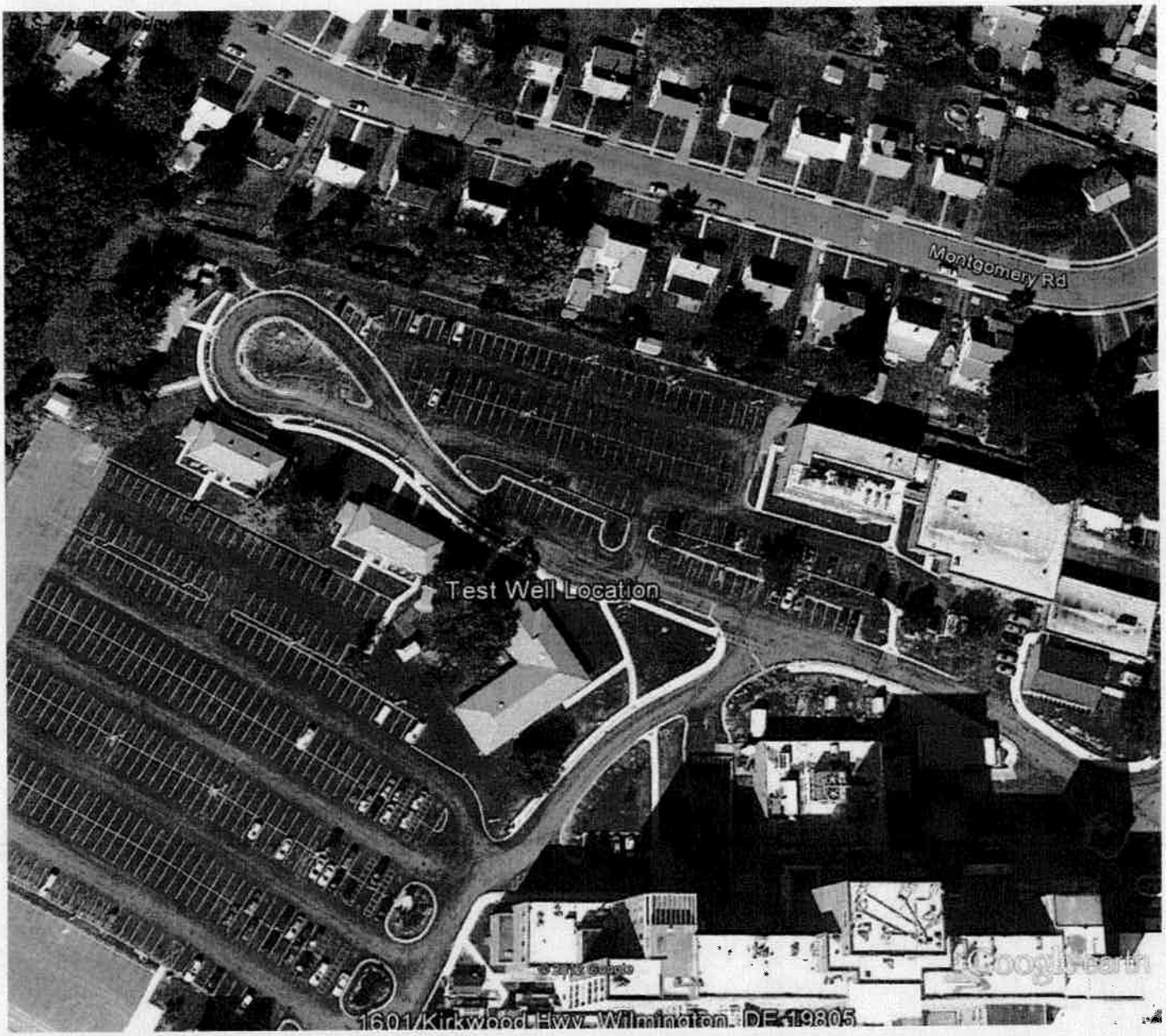
Very truly yours,

DUFFIELD ASSOCIATES, INC.

Stacy B. Ziegler, P.E., LEED AP BD+C
Senior Geotechnical Engineer

SBZ:
WORD\6772GF.0312-VAMC GEOTHERMAL TEST WELL.RPT

Enclosures: Test Well Location Plan
Formation Thermal Conductivity Test and Data Analysis Report



Geothermal Test Well Location Plan
VA Medical Center
Wilmington, DE

Project # 6772.GF
March 2012

FORMATION THERMAL CONDUCTIVITY
TEST & DATA ANALYSIS

TEST LOCATION **VA Medical Center**
Wilmington, DE

TEST DATE February 29 – March 2, 2012

ANALYSIS FOR Duffield Associates, Inc.
5400 Limestone Road
Wilmington, DE 19808
Phone: (302) 239-6634
Fax: (302) 239-8485

TEST PERFORMED BY Duffield Associates, Inc.

EXECUTIVE SUMMARY

A formation thermal conductivity test was performed at the VA Medical Center site at 1601 Kirkwood Hwy, Wilmington, Delaware. The vertical bore was completed on February 23, 2012 by K.L. Madron Well Drilling, LLC. Geothermal Resource Technologies' (GRTI) test unit was attached to the vertical bore on the afternoon of February 29, 2012.

This report provides an overview of the test procedures and analysis process, along with plots of the loop temperature and input heat rate data. The collected data was analyzed using the "line source" method and the following average formation thermal conductivity was determined.

Formation Thermal Conductivity = 1.34 Btu/hr-ft-°F

Due to the necessity of a thermal diffusivity value in the design calculation process, an estimate of the average thermal diffusivity was made for the encountered formation.

Formation Thermal Diffusivity ≈ 0.88 ft^2/day

The undisturbed formation temperature for the tested bore was established from the initial loop temperature data collected at startup.

Undisturbed Formation Temperature ≈ 56-57.7°F

The formation thermal properties determined by this test do not directly translate into a loop length requirement (i.e. feet of bore per ton). These parameters, along with many others, are inputs to commercially available loop-field design software to determine the required loop length. Additional questions concerning the use of these results are discussed in the frequently asked question (FAQ) section at www.grti.com.

TEST PROCEDURES

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has published recommended procedures for performing formation thermal conductivity tests for geothermal applications (ASHRAE 2011 HVAC Applications handbook, pages 32.12-32.13). The International Ground Source Heat Pump Association (IGSHPA) also lists test procedures in their 2010 Design and Installation Standards. GRTI's test procedures meet or exceed those recommended by ASHRAE and IGSHPA, with the specific procedures described below:

Grouting Procedure for Test Loops – To ensure against bridging and voids, it is recommended that the bore annulus is uniformly grouted from the bottom to the top via tremie pipe.

Time Between Loop Installation and Testing – A minimum delay of five days between loop installation and test startup is recommended for bores that are air drilled, and a minimum waiting period of two days for mud rotary drilling.

Undisturbed Formation Temperature Measurement – The undisturbed formation temperature should be determined by recording the loop temperature as the water returns from the u-bend at test startup.

Required Test Duration – A minimum test duration of 36 hours is recommended, with a preference toward 48 hours.

Data Acquisition Frequency - Test data is recorded at five minute intervals.

Equipment Calibration/Accuracy – Transducers and datalogger are calibrated per manufacturer recommendations. Manufacturer stated accuracy of power transducers is less than ±2%. Temperature sensor accuracy is periodically checked via ice water bath.

Power Quality – The standard deviation of the power should be less than or equal to 1.5% of the average power, with maximum power variation of less than or equal to 10% of the average power.

Input Heat Rate – The heat flux rate should be 51 Btu/hr (15 W) to 85 Btu/hr (25 W) per foot of installed bore depth to best simulate the expected peak loads on the u-bend.

Insulation – GRTI's equipment has 1 inch of foam insulation on the FTC unit and 1/2 inch of insulation on the hose kit connection. An additional 2 inches of insulation is provided for both the FTC unit and loop connections by insulating blankets.

Retesting in the Event of Failure – In the event that a test fails prematurely, a retest may not be performed until the bore temperature is within 0.5°F of the original undisturbed formation temperature or until a period of 14 days has elapsed.

DATA ANALYSIS

Geothermal Resource Technologies, Inc. (GRTI) uses the "line source" method of data analysis to determine the thermal conductivity of the formation. The line source method assumes an infinitely thin line source of heat in a continuous medium. A plot of the late-time temperature rise of the line source temperature versus the natural log of elapsed time will follow a linear trend. The linear slope is inversely proportional to the thermal conductivity of the medium. If a u-bend grouted in a borehole is used to inject heat into the ground at a constant rate in order to determine the average formation thermal conductivity, the test must be run long enough to allow the finite dimensions of the u-bend pipes and the grout to become insignificant. Experience has shown that approximately ten hours is required to allow the error of early test times and the effects of finite borehole dimensions to become insignificant.

In order to analyze real data from a formation thermal conductivity test, the average temperature of the water entering and exiting the u-bend heat exchanger is plotted versus the natural log of elapsed testing time. Using the Method of Least Squares, linear equation coefficients to produce a line that fits the data are calculated. This procedure is normally repeated for various time intervals to ensure that variations in the power or other effects are not producing inaccurate results.

The calculated results are based on test bore information submitted by the driller/testing agency. GRTI is not responsible for inaccuracies in the results due to erroneous bore information. All data analysis is performed by personnel that have an engineering degree from an accredited university with a background in heat transfer and experience with line source theory. The test results apply specifically to the tested bore. Additional bores at the site may have significantly different results depending upon variations in geology and hydrology.

Through the analysis process, the collected raw data is converted to spreadsheet format (Microsoft Excel®) for final analysis. If desired, please contact GRTI and a copy of the data will be made available in either a hard copy or electronic format.

CONTACT: Galen Streich
Regional Managing Engineer
Elkton, SD
(605) 692-9069
gstreich@grti.com

TEST BORE DETAILS
(AS PROVIDED BY DUFFIELD ASSOCIATES, INC.)

Site Name	VA Medical Center
Location	Wilmington, DE
Driller	K.L. Madron Well Drilling, LLC
Installed Date	February 23, 2012
Borehole Diameter	6 inches
U-Bend Size	1 1/4 inch HDPE
U-Bend Depth Below Grade	350 ft
Grout Type	Baroid Barotherm Gold
Grout Solids	400 lb sand per 50 lb bentonite
Grouted Portion	Entire bore

DRILL LOG

FORMATION DESCRIPTION	DEPTH (FT)
Topsoil	0'-6'
Brown clay	6'-15'
Brown sand	15'-25'
Brown clay	25'-45'
Sandy gravel	45'-60'
Gneiss	60'-350'

THERMAL CONDUCTIVITY TEST DATA

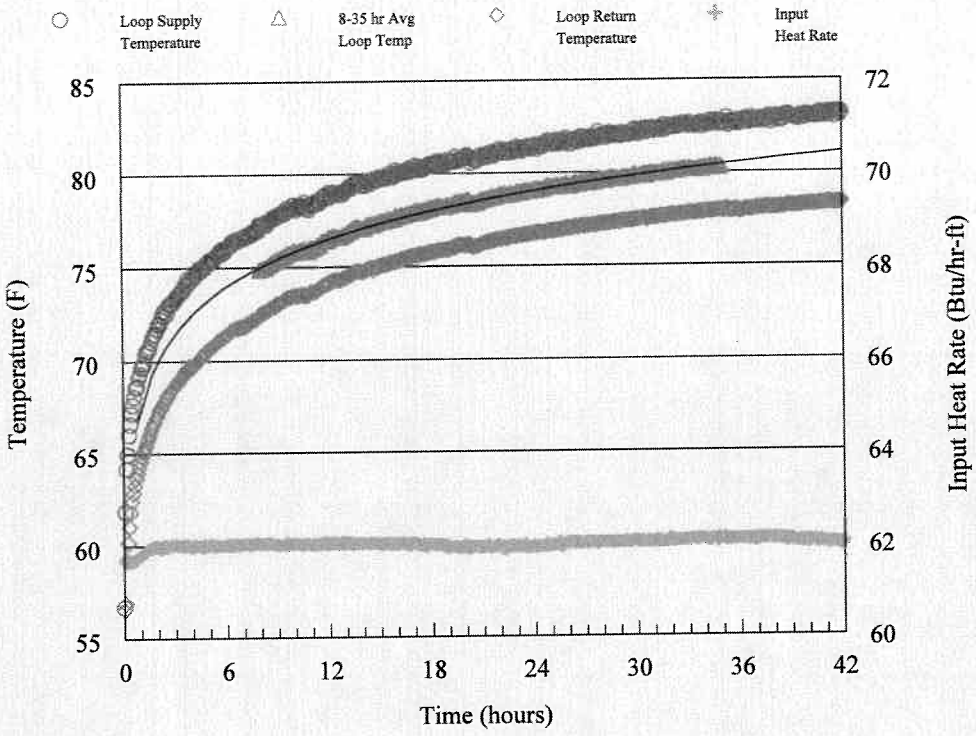


FIG. 1: TEMPERATURE & HEAT RATE DATA VS TIME

Figure 1 above shows the loop temperature and heat input rate data versus the elapsed time of the test. The temperature of the fluid supplied to and returning from the U-bend are plotted on the left axis, while the amount of heat supplied to the fluid is plotted on the right axis on a per foot of bore basis. In the test statistics below, calculations on the power data were performed over the analysis time period listed in the Line Source Data Analysis section.

SUMMARY TEST STATISTICS

Test Date	February 29 – March 2, 2012
Undisturbed Formation Temperature	Approx. 56-57.7°F
Duration	42.1 hr
Average Voltage	240.6 V
Average Heat Input Rate	21,702 Btu/hr (6,359 W)
Avg Heat Input Rate per Foot of Bore	62.0 Btu/hr-ft (18.2 W/ft)
Calculated Circulator Flow Rate	9.2 gpm
Standard Deviation of Power	0.08%
Maximum Variation in Power	0.22%

LINE SOURCE DATA ANALYSIS

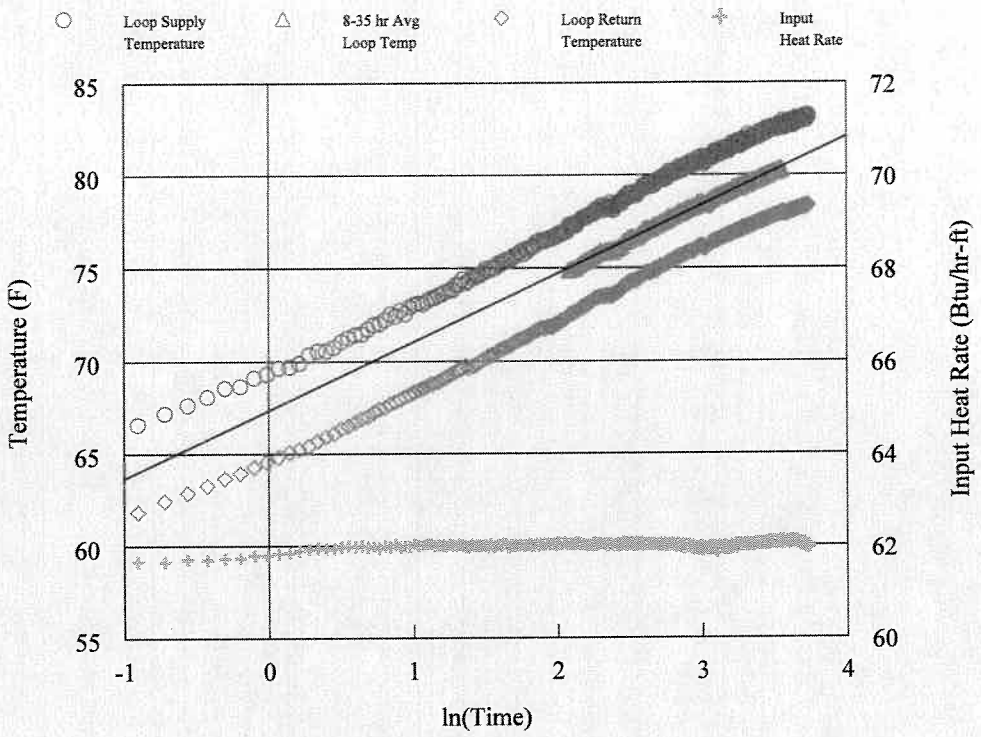


FIG. 2: TEMPERATURE & HEAT RATE VS NATURAL LOG OF TIME

The loop temperature and input heat rate data versus the natural log of elapsed time are shown above in Figure 2. The temperature versus time data was analyzed using the line source method (see page 3) in conformity with ASHRAE and IGSHPA guidelines. A linear curve fit was applied to the average of the supply and return loop temperature data between 8 and 35.0 hr. The slope of the curve fit was found to be 3.68. The resulting thermal conductivity was found to be **1.34 Btu/hr-ft-°F**.

THERMAL DIFFUSIVITY

The reported drilling log for this test borehole indicated that the formation consisted of clay, sand, gravel and gneiss. A heat capacity value for gneiss was calculated from specific heat and density values listed by Kavanaugh and Rafferty (Ground-Source Heat Pumps - Design of Geothermal Systems for Commercial and Institutional Buildings, ASHRAE, 1997). A weighted average of heat capacity values based on the indicated formation was used to determine an average heat capacity of 36.5 Btu/ft^3-°F for the formation. A diffusivity value was then found using the calculated formation thermal conductivity and the estimated heat capacity. The thermal diffusivity for this formation was estimated to be **0.88 ft^2/day**.